EFFECTS OF SUPERVISED AND UNSUPERVISED SKIPPING ROPE TRAINING ON PERCEPTUAL RESPONSES AMONG RECREATIONAL BADMINTON PLAYERS

LIOW KAI LIN

SCHOOL OF HEALTH SCIENCES

UNIVERSITI SAINS MALAYSIA

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by

LIOW KAI LIN

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LIST OF ABBREVIATIONS AND ACRONYMS

%	Percentage
>	Greater than
<	Lesser than
HIIT	High-Intensity Interval Training
SG	Supervised Group
UG	Unsupervised Group
PAR-Q	Physical Activity Readiness Questionnaire
IPAQ	International Physical Activity Questionnaire
HR	Heart Rate
EES	Exercise Enjoyment Scale
FS	Feeling Scale
FAS	Felt Arousal Scale
RPE	Rate of Perceived Exertion
PA	Physical activity
WHO	World Health Organisation
NCD	Non-communicable disease
HREC	Human Research Ethics Committee
ES	Effect size
SD	Standard deviation

M	Mean
cm	Centimeter
kg	Kilogram
kgm^{-2}	Kilogram-meter squared
bpm	Beat per minute
MICT	Moderate-Intensity Continuous Training
SDT	Self-Determination Theory
MCO	Movement Control Order
HVLL	High-Velocity Low-Load
LVHL	Low-Velocity High-Load

KESAN LATIHAN LOMPAT TALI YANG DIAWASI BERBANDING YANG TIDAK DIAWASI TERHADAP TANGGAPAN PERSEPSI DI KALANGAN PEMAIN BADMINTON REKREASI

ABSTRAK

Wabak Covid-19 telah merebak di Malaysia, langkah-langkah yang dilakukan oleh kerajaan adalah jarak sosial dan fizikal, penutupan perniagaan, sekolah dan kehidupan sosial secara keseluruhan termasuk sukan dan aktiviti fizikal. Ramai individu dan atlet tidak dapat mengambil bahagian secara aktif dalam aktiviti sukan. Dalam keadaan begitu, ia akan menyebabkan fizikal kurang aktif dan seterusnya mengakibatkan kenaikan berat badan dan kehilangan kecergasan fizikal. Dalam dekad kebelakangan ini, latihan lompat tali semakin popular dan telah terbukti memberi kesan positif terhadap kecergasan yang berkaitan dengan kesihatan dan kecergasan yang berkaitan dengan spesifik di pelbagai populasi (contohnya atlet, remaja dan berat badan berlebihan). Walau bagaimanapun, tindak balas persepsi (contohnya tanggapan afektif, kesenangan, dan usaha yang dirasakan) latihan lompat tali yang diawasi dan tidak diawasi tidak didokumentasikan dengan baik. Oleh itu, tujuan kajian ini adalah untuk mengetahui kesan latihan lompat tali yang diawasi dengan yang tidak diawasi terhadap tindak balas persepsi di kalangan pemain badminton rekreasi. Sebanyak dua puluh pemain badminton rekreasi yang mempunyai pengalaman lebih dari setahun (n = 20, 5 lelaki dan 15 perempuan, umur = 22,80 ± 0,89 tahun) direkrut dalam kajian rawak dan selari ini. Peserta dibahagikan secara rawak ke dalam dua kumpulan, iaitu kumpulan diawasi (SG) dan kumpulan tidak diawasi (UG). Program latihan ini dilaksanakan tiga kali seminggu selama empat minggu (jumlah 12 sesi). Dalam setiap sesi latihan, peserta melakukan pemanasan badan selama 5 minit,

diikuti dengan 60-75 pengulangan lompatan yang dipisahkan dengan selang pemulihan satu minit dan diakhiri dengan penyejukan badan selama 5 minit. Semua pemboleh ubah bersandar termasuk kadar denyut jantung (HR), skala keseronokan latihan (EES), skala perasaan (FS), skala rasa gairah (FAS) dan kadar aktiviti yang dirasakan (RPE) dicatatkan sebelum, semasa dan selepas setiap sesi. Data dianalisis menggunakan model varians campuran (ANOVA) dilakukan untuk memeriksa perbezaan semua pemboleh ubah bersandar antara kumpulan semasa sesi latihan (sesi 3,6,9, dan 12). Hasil kajian menunjukkan bahawa terdapat peningkatan yang signifikan dalam FS ($p = 0,03$) dan RPE ($p = 0,027$) setelah empat minggu latihan lompat tali. Tanggapan afektif yang diukur oleh FS lebih besar semasa SG berbanding dengan UG di semua sesi sementara respons tanggapan tenaga yang diukur oleh RPE lebih tinggi semasa UG berbanding SG di semua sesi. Walau bagaimanapun, ia tidak menunjukkan perubahan ketara dalam HR ($p = 0.77$), FAS ($p = 0.69$) dan EES ($p = 0.74$). Oleh itu, sebagai kesimpulan, kajian ini menunjukkan bahawa SG menimbulkan perasaan yang lebih baik daripada UG dalam setiap sesi sementara UG menghasilkan RPE yang lebih besar daripada SG pada setiap sesi.

EFFECTS OF SUPERVISED AND UNSUPERVISED SKIPPING ROPE TRAINING ON PERCEPTUAL RESPONSES AMONG RECREATIONAL BADMINTON PLAYERS

ABSTRACT

The global outbreak of Covid-19 has spread in Malaysia, social and physical distancing measures, lockdowns of businesses, schools and overall social life have disrupted many regular aspects of life, including sport and physical activity. Many individuals and athletes are not able to actively participate in their regular individual or group sporting activities. Under such conditions, it leads less physically active and hence resulting in weight gain and loss of physical fitness. Recently, skipping rope exercise is getting popular and has been shown to elicited positive effect on health-related fitness and specific-related fitness across multiple populations (e.g., athletes, adolescents and overweight). However, the perceptual responses (e.g., affective responses, enjoyment, and perceived exertion) of supervised and unsupervised skipping rope training is not well documented. Hence, the purpose of this study is to determine the effects of supervised vs unsupervised skipping rope training on perceptual responses among recreational badminton players. A total of twenty recreational badminton player with more than one-year badminton experienced (n=20, 5 males and 15 females, age = 22.80 ± 0.89 years) were recruited in this randomised and parallel study. Participants were randomly assigned into two groups, namely supervised group (SG) and unsupervised group (UG). This training program was carried out three times per week for four weeks (a total 12 sessions). During each exercise session, participants performed warming up for five minutes, followed by 60-75 jump repetitions separated by one minute recovery interval and ended with cooling down for five minutes. All the dependent variables including heart rate (HR),

exercise enjoyment scale (EES), feeling scale (FS), felt arousal scale (FAS) and rate of perceived exertion (RPE) were recorded before, during and after each session. Data were analysed using a mixed model of variance (ANOVA) was performed to examine differences in all dependent variables between groups over training session (sessions 3,6,9, and 12). The results showed that there were significant increases in FS ($p = 0.03$) and RPE ($p = 0.027$) between supervised and unsupervised group following four weeks of skipping rope training. Affective responses measured by FS were greater during SG compared to UG across all sessions meanwhile perceived exertion responses measured by RPE were higher in UG compared to SG across all sessions. However, it showed no significant changes in HR ($p = 0.77$), FAS ($p = 0.69$) and EES ($p = 0.74$). Thus, in conclusion, this study showed that SG elicited better feeling than UG in every session while UG elicited greater RPE than SG in every session. Further studies are needed for in depth understanding of the perceptual responses between supervised and unsupervised intervention method.

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The global outbreak of Covid-19 has spread in Malaysia, social and physical distancing measures, lockdowns of businesses, schools and overall social life have disrupted many regular aspects of life, including sport and physical activity. Most of the regular training of athletes are affected due to the closure of gyms, stadiums, fitness studios, parks and playgrounds. Many individuals and athletes are not able to actively participate in their regular individual or group sporting activities. Under such conditions, it leads less physically active and hence resulting in weight gain and loss of physical fitness. Therefore, there is a strong rationale to study alternative forms of PA or exercise in adults, with one strategy focussing on home-based type of exercise.

There is a multiple home-based exercise training program available with one potential approach is adopting skipping rope as method of exercise training. Skipping rope is a simple, cheap, and portable material which is affordable to everyone. Available evidences have indicated the effectiveness of skipping rope on physical fitness in adults (e.g. body composition, flexibility, cardiovascular endurance, power, agility and muscular strength) (Chen & Lin, 2011; Makaruk, 2017; Veena Kirthika *et al.*, 2019; Prasanna, 2020; Yang *et al.*, 2020). Furthermore, a meta-analysis study conducted by Slimani et al., (2016) has reported that this type of training appears to promote multiple physical improvements as short as four weeks of interventions. This plyometric type of exercise also could be performed anytime or anywhere. Thus, given the current global pandemic of Covid-19, this training program could be the most suitable approach especially when outdoor activities are prohibited during the lockdown period. However, there is still considerable controversy about its implementation and effectiveness from a

public health perspective, as skipping rope exercise involve with intense exercise which may not be feasible for a large sedentary spectrum of the population who may not tolerate intense exercise (Follador *et al.*, 2018). Main arguments against high intensity training suggest that it will undermine self-efficacy and elicit unpleasant feelings that may be linked in turn to poor exercise adherence (Biddle & Batterham, 2015).

To participate in exercise, enjoyment is important motive for engaging in physical activity or exercise (Aaltonen *et al.*, 2012) as much as the amount of perceived exertion and pleasure participants experience during the exercise might influence their future engaging behaviour. The hedonic theory also suggests that if someone derives pleasure or enjoyment from an activity, he or she will probably repeat this behaviour (Cabanac, 1971) and it also explained that human behaviour is motivated by the pursuit of pleasure and the avoidance of displeasure (Mees & Schmitt, 2008). Affective responses (feelings of pleasure and displeasure) could help to predict individual future physical activity long-term participation and behaviour if the exercise brings positive affect, improved mood, and decreased stress levels (Kiviniemi, Voss-Humke & Seifert, 2007; Williams *et al.*, 2008). Therefore, understanding the affective responses to resistance exercise is important and could be used to influence skipping rope exercise program design in adults.

The manner in which exercise is prescribed and monitored may influence individuals' perceptual responses (affective responses and enjoyment). Within the context of training program, exercise can be prescribed in either a supervised or unsupervised manner. With supervised method, adherence to the exercise prescription (e.g., duration, frequency, intensity, and type) can be closely monitored and verified. Whereas unsupervised activity can be done in any environment or at any time that best suits the individual which may reflect a "real-world" scenario. Currently, there is limited study to investigate the effects of supervised and unsupervised skipping rope training session on

perceptual responses (affective response, perceived exertion and enjoyment).

Therefore, the purpose of the present study was to investigate the effects of supervised and unsupervised skipping rope training program on perceptual responses among recreational badminton players.

1.2 PROBLEM STATEMENT

Studies have shown that supervised exercise provided positive effects on the outcome (motivation and health-related fitness) but there is limited evidence to support the supervised and unsupervised skipping rope training session could generate different perceptual responses particularly in recreational badminton players. Thus, this study will provide potentially valuable information pertaining to the impact of skipping rope under supervision on the recreational badminton players' perceptual responses. This proposed study provides guideline to exercise prescription that may promise greater behavioural engagement and adherence to the training program.

1.3 OBJECTIVES OF THE STUDY

1.3.1 General objective

To determine the effects of supervised vs. unsupervised skipping rope training program on perceptual responses among recreational badminton players.

1.3.2 Specific objectives

1. To assess the affective responses between supervised vs. unsupervised skipping rope group among recreational badminton players.
2. To assess the enjoyment responses between supervised vs. unsupervised skipping rope group among recreational badminton players.
3. To assess the perceived exertion responses between supervised vs. unsupervised skipping rope group among recreational badminton players.

1.4 RESEARCH QUESTIONS

1. Is there any significant difference in affective responses between supervised and unsupervised skipping rope training program among recreational badminton players?
2. Is there any significant difference in enjoyment responses between supervised and unsupervised skipping rope training program among recreational badminton players?
3. Is there any significant difference in perceived exertion responses between supervised and unsupervised skipping rope training program among recreational badminton players?

1.5 HYPOTHESES OF THE STUDY

Ho1: There is no significant difference between supervised and unsupervised skipping rope group on affective responses among recreational badminton players.
Ha1: There is significant difference between supervised and unsupervised skipping rope group on affective responses among recreational badminton players.

Ho2: There is no significant difference between supervised and unsupervised skipping rope group on enjoyment responses among recreational badminton players.

Ha2: There is significant difference between supervised and unsupervised skipping rope group on enjoyment responses among recreational badminton players.

Ho3: There is no significant difference between supervised and unsupervised skipping rope group on perceived exertion responses among recreational badminton players.

Ha3: There is significant difference between supervised and unsupervised skipping rope group on perceived exertion responses among recreational badminton players.

1.6 SIGNIFICANCE OF THE STUDY

Given the limitation of performing any form of exercise during the pandemic of Covid-19, it is crucial to identify strategy to maintain physical fitness of recreational athletes. The reinforces the need to evaluate both psychological and physiological factors in research exploring skipping rope training as an effective health strategy in athletes. Elucidating this information is important, as skipping rope training that are capable of preserving pleasurable during exercise could encourage future attitudes towards physical activity behaviour in individuals. Furthermore, the establishment of physiological responses during skipping rope exercise could reflects the sufficient threshold achieve to promote optimal health benefits. Thus, this study might provide another alternative way to athletes or even general populations to exercise by using skipping rope and practice a healthy lifestyle to reduce the risk of chronic diseases while promoting exercise adherence.

1.7 OPERATIONAL DEFINITIONS

High-Intensity Interval Training (HIIT):

Repeated, brief bouts of high intensity exercise (≥80% of maximal heart rate [HRmax]), interspersed by short recovery period either light-intensity exercise (40 – 50% HRmax) or rest.

Self-Determination Theory (SDT)

Theory of human motivation and personality in social contexts that differentiates motivation in terms of being autonomous or controlled.

Affective response

General psychological state of an individual, including but not limited to emotions and mood, within a given situation. It used to describe an individual's subjective experience (i.e., intrapersonal, or experiential core) of all valence responses (positive and negative dimensions).

Perceived exertion response

Subjective intensity of effort, strain, or fatigue that the individuals can feel during exercise.

Exercise enjoyment response

A positive response to the movement experience that reflects feelings such as pleasure, liking, and fun derived from the activity.

Physical inactivity

Regular physical activity does not meet by the recommended guidelines by WHO for at least 150 – 300 minutes of moderate-intensity exercise or 75 – 150 minutes of vigorous-intensity exercise.

CHAPTER 2: REVIEW OF LITERATURE

2.1 Supervised and Unsupervised Training Program

Exercising over the long-term is promising optimal health benefits from non-communicable diseases (Courneya, Karvinen & Vallance, 2007). Supervised physical activity typically completed in a health-fitness facility under the direct supervision of trained exercise instructor, such that adherence to the exercise prescription can be monitor (Creasy *et al.*, 2017). Given the importance of long-term adherence, supervised training program was constructed by giving motivation has shown a great deal of more intrinsically and extrinsically motivated (Milne *et al.*, 2008). These patterns were replicated for the psychological needs of competence, autonomy, and relatedness. The study result proved that supervised training program developed more self-determined regulations for exercise rather than unsupervised group. Few studies indicated that short-term supervised exercise programs have been shown to improve physical fitness and health outcomes (Speck *et al.*, 2010) however it often criticized for the short-term effects on motivation and behaviour change. Milne st al. (2018) examined the effects of 12 weeks of supervised exercise program on motivational outcomes by using the self-determination theory (SDT) demonstrated that there were improvements in the supervised group rather than unsupervised group. However, there are inconsistent findings for changes in physical activity, physical fitness and weight in the previous comparisons of supervised and unsupervised exercise programs (Perri *et al.*, 1997; Andersen *et al.*, 1999). Given the equivocal findings related to this area of investigations, more study needs to be conducted particularly to the specific exercise training program to establish potential benefits of supervised and unsupervised mode on psychological and physiological responses in adults.

2.2 Skipping Rope Training

Skipping rope is an active exercise that should done in a different intensity jumping movements in a significant implementation of developing the muscular strength and cardiovascular system to help preparation for different sports activity and improve full body movements (Prasanna, 2020). Repetitive jumping movement by using skipping rope with repeated bouncing will allow lower body adaptation to be more elastic and stores and release energy more effective. Therefore, it will lead to a better consecutive explosive ability and movement. Skipping rope has been widely used by athletes like volleyball players, track and field athletes, soccer players and badminton players or adolescent to enhance their health-related fitness and skill-related fitness (Chen & Lin, 2012; Trecroci *et al.*, 2015; Makaruk, 2017; Prasanna, 2020; Yang *et al.*, 2020).

The role of skipping rope exercise within training programs has been proved that it gives positive effects on physiological parameters of cardiovascular and respiratory system (Hatfield, Vaccaro & Benedict, 1985; Fergusson *et al.*, 2013; Trecroci *et al.*, 2015). To elicit the long-term participation of exercise and improve physical fitness, several previous literature demonstrated that both supervised exercise and unsupervised exercise programs have shown positive result on enhancing strength and cardiovascular fitness (Simons-Morton *et al.*, 1998; Olney *et al.*, 2006). However, there are mixed results of whether supervised or unsupervised exercise is more effective. Also, evidence has indicated that a supervised program may be an important factor in providing long-term motivation across the training session that require challenging situation (e.g. high-intensity exercise) (Courneya *et al.*, 2012).

2.3 Affective Responses

Affect is a response that is elicited somewhat reflexively or instinctively without significant thought and is linked to pleasure or displeasure and tension or calmness. People are doing exercise during their leisure time for variety of reasons. One of the most important of these is motivation, which influences physical activity participation and especially, intention to continue participation (Aaltonen *et al.*, 2012). Long-term exercise usually reported increased positive affect during and following physical activity (Arent, Landers & Etrier, 2013). This association of positive affect with exercise leads to increase motivation to engage in physical activity (Laverie, 1998) and prospectively predicts future activity behaviour (McAuley *et al.*, 2003). However, an aerobic HIIT training highly affects the level of cortisol-stress hormone (Herodek, 2014) and has been linked to negative affective responses (Ekkekakis, Hall & Petruzzello, 2005). A research showed that affective responses are modulated not only by exercise intensity, but also by perceived exertion (Ramalho Oliveira *et al.*, 2015) therefore elucidating this information is very important as affective evaluation during exercise may influence future attitudes towards physical activity behaviour (Schneider, Dunn & Cooper, 2009).

2.4 Perceived Exertion Responses

Prescribing the intensity of training bouts using the rating of perceived exertion (RPE) is highly attractive because of its simplicity and versatility (Dishman *et al.*, 1987). The use of session rating of perceived exertion to evaluate and quantify internal training load is considered a potential tool in different sports (Haddad *et al.*, 2017). RPE is correlated with a variety of psychophysiological variables. Physiological variables that relate to perceptions of effort include metabolic rate, ventilation, blood flow, and muscular fatigue (Robertson & Noble, 1997) while psychological considerations that are linked to exertion include motivation, mood state, arousal, mental stress, pacing, and exercise experience (Robertson & Noble, 1997; Tucker, 2009). A research study indicated that 6 seconds interval sessions producer lower RPE values than 24 seconds interval sessions when equated for total work and work-to-rest ratio (Ekkekakis, Hall & Petruzzello, 2005). Moreover, several studies stated exertional responses tend to increase over time during interval exercise trials regardless of interval intensity or rest duration despite interval segments remaining unchanged throughout the session (Seiler & Sjursen, 2004; Price & Moss, 2007; Uniga *et al.*, 2011).

2.5 Exercise Enjoyment Responses

An important influence on physical activity adherence is the level of perceived exercise enjoyment (Logan *et al.*, 2014). Enjoyment is a psychological state that is unique in that it is elicited after appraising or cognitively evaluating in a situation. Hence, the studies investigating the effects of HIIT on perceived enjoyment responses increases in recent years possibly because enjoyment could be a mediator of exercise adherence (Jekauc, 2015). Previous studies also have shown that significantly greater enjoyment was experienced in the HIIT group compared to moderate-intensity continuous exercise (Bartlett *et al.*, 2011; Soares, 2013; Martinez *et al.*, 2014; B. Bond *et al.*, 2015; Bert Bond *et al.*, 2015). Compared with the "boring" steady-state continuous exercise, there are two studies commented that HIIT would have greater post-exercise feelings of enjoyment due to the varied nature of the activity profile inherent (Wisløff *et al.*, 2007; Tjønna *et al.*, 2008).

CHAPTER 3: METHODOLOGY

3.1 STUDY DESIGN

The present study utilised a repeated measure, within-subjects, parallel group design in which each participant will be assigned into supervised training group (SG) and unsupervised training group (UG) using simple randomization (Random Allocation Software, 1.0.0) in the first visits. No control group included for this study. Duration of participants' involvement in this study was up to four weeks. Participants were recruited based on the inclusion and exclusion criteria that were set for this study (see Table 3.4). Heart rate (HR), rating of perceived exertion (RPE). feeling scale (FA), felt arousal scale (FAS) and exercise enjoyment scale (EES) were taken before, during and after the sessions. Participants required to follow the training program that prescribed in Table 3.2. This study procedures were approved (Appendix A) by Human Research Ethics Committee (HREC), Health Campus of Universiti Sains Malaysia (USM/JEPEM/21010018). This study had no conflict of interest.

3.2 STUDY LOCATION

The data collection was conducted through online. All the participants performed this training program as home-based exercise.

3.3 SAMPLE SIZE CALCULATION

Sample size was calculated by using G*Power version 3.1.9.2. The sample size reflects related studies for the dependent variables (i.e. affective responses, enjoyment responses and exertional stress responses) which have been shown to have a medium effect size. To the current study, where two groups (supervised and unsupervised) analysed using a two-way mixed analysis of variance (ANOVA), a sample size of 20 participants (10 participants in each group) required to detect a moderate effect using a power of 0.8, an alpha of 0.05 and an effect size, F, of 0.30 (medium). The potential participants recruited via advertisement that posted via email or poster spread through WhatsApp and Telegram.

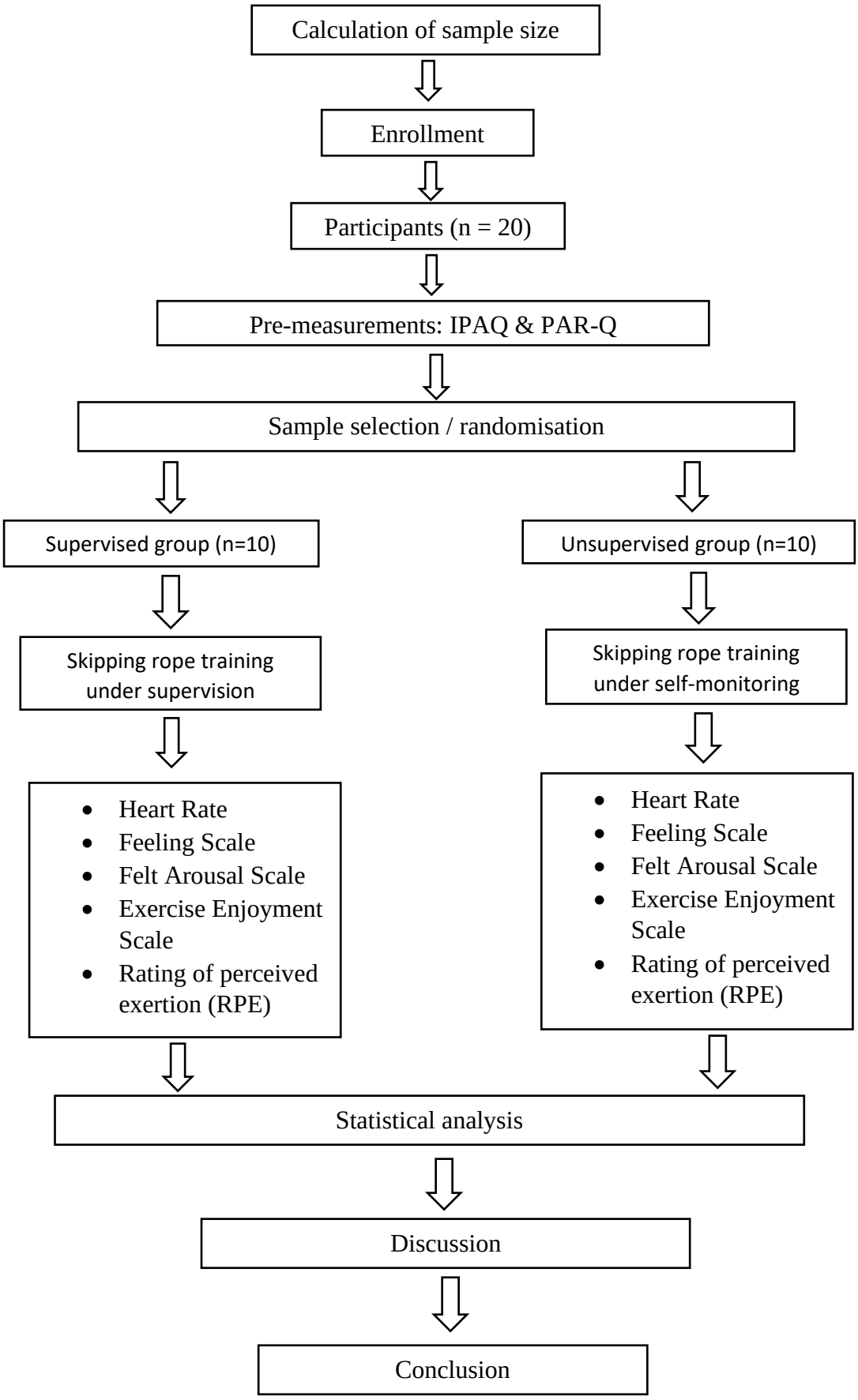

Figure 3.1: Flow chart of the study procedures

3.4 PARTICIPANTS

A total of twenty healthy physically active male and female were recruited among students of USM via poster advertisement (Appendix B) sent through WhatsApp and Telegram. Before randomisation, the participants were required to meet the following inclusion/exclusion criteria as below. The researcher gave informed consent form after being advised of all possible risks and discomforts associated with the procedures used in this study. Note that participants will not be compensated for participation in this study. If the participants experience physical injury during the intervention period, the researcher will refer them to the USM clinic if treatment is needed.

This selection criteria were as follow:

Table 3.4: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
19 – 25 years old	Having any form of disability either mentally or physically
Male and Female	Under medications or substances known to influence cardiovascular responses to exercise
Free from any musculoskeletal injuries	
More than one-year experience playing badminton recreationally	

3.5 STUDY OVERVIEW

During the recruitment process, potential participants were approached by researcher and they were thoroughly explained regarding the objectives, procedures, possible risks, and benefits of the research study. This was followed by a four week exercise intervention consisting of SG and UG, with three exercise sessions per week (a total of 12 sessions) in the home-based setting. Each of the participants was assigned to perform the exercise test at the same time of the day between the hours of 16:00 to 18:00. All exercise training were performed using similar brand of rope provided by researcher.

3.5.1 Anthropometric and physical activity

Body mass and stature were measured to the nearest 0.1 kg and 0.1 cm, respectively (the participants were shoeless and wear light clothing) by a body composition analyzer (Tanita, Japan) and a stadiometer (Seca, China) respectively. Body mass index (BMI) was calculated as body mass (kg) divided by height (m) squared. Participants completed Malay versions of the International Physical Activity Questionnaire sort form (IPAQ-M; reference) to determine habitual PA levels. IPAQ-M can be divided into three levels of categorical score that consists of Category 1 (Inactive, <600 MET – minutes/week), Category 2 (moderately active; <3000 MET – minutes/week) and Category 3 (health-enhancing physical activity (HEPA); >3000 MET – minutes/week).

3.5.2 Affective responses

The Feeling Scale (FS; Hardy & Rejeski, 1989) was used as a measure of "basic" or "core" affective valence (pleasure-displeasure). Participants responded to how they feel on an 11-point bipolar scale ranging from "Very Good" (+5) to "Very Bad" (-5). Perceived activation levels were measured using the single item felt arousal scale (FAS; (Svebak & Murgatroyd, 1985). Participants were asked to rate themselves on a 6-point scale ranging from 1 'low arousal' to 6 'high arousal'. FS and FAS exhibited correlations ranging from 0.41 to 0.59 and 0.47 to 0.65, respectively, with the Affect Grid (Russell et al, 1989), indicative of convergent validity with similar established measures (Van Landuyt et al., 2000). Participants responded to the FS and FAS before exercise, during, and immediately after exercise. Participants were also given standardized verbal instructions on how to use the scales before undertaking the incremental test and at the start of the exercise session using the below sentences:

Feeling Scale: *While participating in exercise, it is quite common to experience changes in mood. Some individuals find exercise pleasant, whereas others find it to be unpleasant. Additionally, feeling may fluctuate across time. That is, one might feel good and bad a number of times during exercise. How does above scenario make you feel during the exercise?*

Felt Arousal Scale: *Estimate here how aroused you actually feel. By "arousal" we meant how "worked up" you feel. You might experience high arousal in one of a variety of ways, for example as excitement. Low arousal might also be experienced by you in one of a number of different ways, for example as relaxation or boredom or calmness.*

3.5.3 Exercise enjoyment scale

Participants rated their enjoyment during the exercise conditions to the statement "Use the following scale to indicate how much you are enjoying this exercise session" on a 7-point (i.e., "Not at all" at 1 to "Extremely" at 7) exercise enjoyment scale (EES; Stanley and Cumming, 2010). Stanley et al. (2009) report that EES exhibited correlations ranging from 0.41 to 0.49 with the FS, indicative of convergent validity with similar established measures. Participants responded to the EES during the skipping rope exercise.

3.5.4 Rating of perceived exertion

To measure participants' perceived exertion in skipping rope training program, the Borg's Rating of Perceived Exertion was used. The low and high perceptual anchors for the Borg's RPE scale were established during the skipping rope sessions. RPE includes 15 category scales, ranging from 6 to 20, representing eight levels of exercise intensity: no exertion at all (6), extremely light (7-8), very light (9-10), light (11-12), somewhat hard (13-14), hard or heavy (15-16), extremely hard (19), and maximal exertion (20). The test is reliable and valid in the assessment of perceived physical work intensity (Borg, Ljunggren & Ceci, 1985).

3.5.5 Skipping rope training program

The researcher randomly assigned the participants into two groups namely, supervised skipping rope group (SG) and unsupervised skipping rope group (UG), using simple randomisation (Random Allocation Software, 1.0.0). Each exercise groups matched by gender.

In SG group, participants completed skipping rope training program for four week, three exercise sessions per week (a total of 12 sessions) with the online supervision by researcher (i.e., closely monitor the exercise regime and provide encouragement towards the exercise session). Similar exercise intervention to be performed in UG group but without any supervision from the researcher. Each exercise session separated by a minimum two-day rest period (48 hours). A day before the exercise began, researcher conducted a familiarisation session to both groups to help them adapt into the study flow. Participants performed the exercise session at the same time of the day between the hours of 16:00 to 18:00 to minimise the effects of diurnal biological variation. In this study, work duration was fixed but progressively increased the repetition (+5 repetitions) and total work duration (+5 minutes) every week as conducted as previous study (Partavi, 2013). Affect responses (i.e., feelings of pleasant and unpleasant), perceived exertion and enjoyment responses measured across all exercise intervention (before, during and after exercise session).

After completed every week training program sessions, participants have to send all the measurement outcomes to the researcher in softcopy through email.

Table 3.5: Skipping rope training program

Week	Intensity (jumps/min)	Warm-up (5 minutes)	Exercise	Cool-down (5 minutes)
1	60	Stretching	60 reps x 1 min with 60 secs recovery (15 mins)	Stretching
2	65		65 reps x 1 min with 60 secs recovery (20 mins)	
3	70		70 reps x 1 min with 60 secs recovery (25 mins)	
4	75		75 reps x 1 min with 60 secs recovery (30 mins)	

3.6 STATISTICAL ANALYSIS

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS v21, SPSS Inc., Chicago, IL, USA). All the data was presented as mean ± standard deviation (SD). Data recorded during training session 3 (week 1), 6 (week 2), 9 (week 3), and 12 (week 4) were included in the data analyses. Independent t-test was adopted to find the statistical difference between the groups. A two-factor mixed analysis of variance (ANOVA) design with the between factor 'group' (supervised vs unsupervised) and the repeated factor time (sessions 3,6,9 and 12) was used to analyse all data. In the event of significant effects ($p<0.05$), follow-up Bonferroni post hoc test was conducted to examine the location of mean differences. The magnitude of mean differences was interpreted using effect size (ES calculated using Cohen's d Cohen, 1988), where an ES of 0.20 was a small change between means, and 0.50 and 0.80 interpreted as a moderate and large change respectively.

CHAPTER 4: RESULTS

4.1 PHYSICAL AND PHYSIOLOGICAL CHARACTERISTICS

The participants' descriptive characteristics are presented in Table 4.1. Twenty healthy physically active individuals (5 males and 15 females) and have more than one year of experience in playing badminton participated and completed the skipping rope training program during the four week of intervention program. According to the international cut-off points for BMI, two out of twenty participants were categorised as overweight (Cole *et al.,* 2000). The data were analysed by descriptive statistics and expressed in means ± standard deviations (SD). All participants completed the full training program with no adverse effect reported.

Table 4.1: Physical and physiological characteristics

Variables	**Mean ± SD**		**P-value**
	SG (N=10)	**UG (N=10)**	
Age (years)	22.60 ± 0.97	23.00 ± 0.82	0.378
Height (cm)	159.7 ± 6.31	162.1 ± 8.99	0.402
Weight (kg)	55.50 ± 6.17	58.40 ± 9.34	0.039
BMI ($kg.m^{-2}$)	21.77 ± 2.09	22.11 ± 2.11	0.673
HR_{max} (bpm)	197.4 ± 0.97	197.0 ± 0.82	0.378